

SECTION 16738

WIRELESS COMMUNICATION SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

This specification sets forth the minimum acceptable physical, electrical, installation, configuring and testing of wireless communication system into controller cabinets at intersections throughout the City of Houston. All items furnished under this contract shall be new unused materials of the latest product in production to the commercial trade, and shall be of the highest quality as to materials and workmanship.

1. Description. This Item governs the furnishing and installation of Wireless Ethernet Radio (WER) as shown on the plans and as directed by the City's Intelligent Transportation Systems (ITS) Engineer.

Provide all similar WER from the same manufacturer. Provide new, corrosion resistant materials furnished, assembled, fabricated or installed under this Item in strict accordance with the details shown on the plans and in the specifications.

Provide an interference analysis for each location to identify potential sources of interference. Adjust antenna polarities and channel plans on equipment to minimize interference from other sources. If the interference analysis shows possibility for interference at the City sites, conduct in-field monitoring to determine if actual interference exists.

Provide all licenses, where required, for any software, hardware, or equipment in the system. Supply, from the equipment manufacturer, a medical statement as to the safety of the unit to the general public (example: Pacemakers, etc.).

2. Materials. Provide a Wireless Ethernet Radio (WER) that is a point to point or point to multi-point, license-free, radio a minimum data rate of 512 kbps at a 20 mile range.

Supply a WER that uses Frequency Hopping Sequence Spread Spectrum technology. Supply a WER with a serial port that can be used for configuration. Provide an auto-sensing Ethernet port for the connectivity. Furnish a radio that has frequencies which are software selectable with a minimum of 139 channels in the 900 MHz band. The radio will be software

configurable via a serial port or with telnet or WER Graphic User Interface through the Ethernet port.

Equip the WER with a minimum of one RP-TNC connector that allow the deployment of omni-directional or unidirectional external antennas.

Use power and signal cables that are, at a minimum, UV rated Category 6 cables.

A. Contractor Experience Requirements. Minimum requirements for the Contractor or designated subcontractors involved in the installation and testing of the WER are:

- Three years experience in the installation of WER System.
- Two installed WER systems where Systems have been in continuously satisfactory operation for at least 1 year. Submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the system.
- Provide all necessary documentation of subcontractor qualifications pursuant to contract award.

3. Equipment.

A. Furnish WER that meet the minimum requirements:

1. Radio	
Output power (adjustable)	100mW to 1W, user configurable
Frequency Range	902-928 MHz
Receive Sensitivity	-106 dBm @ 256 Kbps @BER=10E-6 -100 dBm @ 512 Kbps @BER=10E-6
RF Technology	Frequency Hopping Spread Spectrum 200 KHz channel spacing
Wireless Data Rate (Mbps)	512 kbps
Range	Up to 45 km (30 miles) at 512 Kbps
Certification	Federal Communications Commission (FCC)
2. Network Support	
Network Connection	10/100BaseT, IEEE 802.3 compliant, RJ-45
VLAN (802.1q) Compliance	Yes
3. Wireless Networking	
Network Topologies	Point-to-Point, and Point-to-Multi-point, Multi-point to Point, Peer
4. Security	128 Bit WEP
Authentication	802.1X support including LEAP to yield mutual authentication and dynamic per-user,

	per-session encryption keys
Encryption	Temporal Key Integrity Protocol (TKIP), Key hashing (per-packet keying) and Message Integrity Check (MIC) Advanced Encryption Standard (AES)-ready
5. Management	
Remote Management	Telnet, HTTP, FTP, Trivial FTP (TFTP), SNMP
Management port	RS-232 Serial
6. Receiver	
Type	Double Heterodyne
Maximum RF Input	-20 dBm
Unfaded BER	Typically Better than BER $10^{-6}$
Frequency Stability	+/-5 ppm
7. Antenna	
External	Unidirectional (Yagi)
External	Omni-directional
8. Status Indicators / Diagnostics	
External LED Indicators	LEDs: Power, Transmit Data and Receive Data
Alarms	Radio TX, Radio RX, BER Threshold
Status	NMS IP Addresses, BER, TX Power, Receive Signal Level, Loopback Test status, Ethernet Input
Configuration Commands	NMS IP Address, TX Power, TX Mute, ATPC, Frequency, RSL, BER Alarm, Loopback Tests, BER Tests
Diagnostic Testing Features	Bit Error Rate (BER), Local/Remote/RF Loopback Performance Monitoring Receive Signal Strength Indicator (RSSI)
Environmental Operating Range	Temperature -40°C to +80°C Humidity 10% to 95% (non-condensing)

**B. Mechanical Requirements.**

1. Provide equipment that is modular in design such that it can be easily replaced in the field.
2. Clearly identify the unit with name, model number, serial number, blank line for IP addressing and any other pertinent information required to facilitate equipment maintenance.
3. Supply a WER with maximum dimensions of 13.0 in. x 13.1 in x 3.12 in and weigh 8 lbs maximum, in a NEMA 4 rated enclosure.

4. Coat printed circuit boards with a clear-coat moisture and fungus resistant material (conformal coating).
  - C. Radio Antenna. Furnish radio antennas per the WER manufacturer requirements. As a minimum, antennas should have the following characteristics:
    1. Unidirectional (Yagi), Minimum 9 dB gain (dB reference to half wave dipole)
    2. Omni-directional, Minimum 6 dB gain (dB reference to half wave dipole)
    3. Wind Rating – 125 miles per hour
    4. Use heliax type for all cable runs. Install cable connectors in accordance with manufacturer's recommendations. Install cable as shown on the plans or as directed by the City's ITS Engineer. The heliax type cable with the following minimum characteristics:
      - a. Impedance: 50 Ohm
      - b. Attenuation: 0.8 dB/100 ft or less @ 894 MHz
      - c. Velocity Factor: 90% or better
      - d. Nom. Capacitance: 25 pF/ft or less
      - e. DC Resistance: 0.5  $\Omega$ /meter
      - f. Core insulation: Semi solid polyethylene or better
      - g. Center Conductor: Solid
      - h. Outer diameter: 0.405 inches outer diameter
      - i. Shield: Greater than 95%
      - j. Dielectric: Foam PE
      - k. Outer jacket: Black PE PVC, UV protected
  - D. Battery Backup System. Supply a battery backup system to provide a minimum of 2 hours of run time in the absence of power. For WER installed in an air conditioned facility, provide a 0.5KVA Uninterruptible Power Supply in accordance with Special Specification, "Uninterruptible Power Supply." For WER installed in a non-environmentally controlled facility, provide a 0.5KVA field hardened battery backup system in accordance with Special Specification, "Battery Backup System."
  - E. Environmental Requirements. Furnish equipment that is capable of continuous operation over a temperature range of -40° to +175°F and a humidity range of 0% to 90% (non-condensing).
  - F. Documentation Requirements. Provide documentation requirements in accordance with the Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty", Article 4.
4. Construction.

- A.** Utilize the latest available techniques for equipment design and construction, with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.
- B.** For all external screws, nuts, and locking washers, use stainless steel. Do not use self-tapping screws unless specifically approved by the Engineer.
- C.** Fabricate all parts of corrosion resistant material, such as plastic, stainless steel, anodized aluminum or brass.
- D.** Protect all materials used in construction from fungus growth and moisture deterioration.
- E.** Separate dissimilar metals by an inert dielectric material.
- F.** System Installation. Provide and install all materials, including support, calibration and test equipment, to ensure an operating and functional wireless system. This includes installation of WER equipment with power and data cables, and the Power and Grounding System. Prior to beginning installation, inspect each site to verify suitability of installation and submit an installation design and a grounding and lightning protection design to the Engineer for approval prior to installation. This installation includes:
  - 1.** Antenna Mounts. Providing and installing antenna mounts, standoffs, brackets and hardware, transmission line, hanger kits and grounding kits. Install all antennas at specified center lines. Perform antenna alignment for each path and compare with path calculations.
  - 2.** System Power and Grounding. Describe the proposed grounding and lightning protection design. Connect equipment to the 115 Volt circuits provided at the sites. Bond all equipment racks in accordance with the approved Installation Specification. Ground all equipment racks to the single-point ground for the site. Provide grounding and lightning protection for all cable runs on the support tower and at the equipment entry point.
  - 3.** System Optimization. Following installation of the completed system, optimize the equipment at each site in accordance with the specifications to provide a complete, operational system.
- G.** Power Requirements. Furnish a WER that operates at input voltage range of +10 - +48 VDC, from a separate solar power supply to be provided as part of a separate bid item. Maximum allowable power consumption for WER is 2Watts.

1. Wiring. Install wiring meeting the requirements of the National Electrical Code. Cut all wires to proper length before assembly. Do not double back any wiring to take up slack. Neatly lace wires into cable with nylon lacing or plastic straps. Secure all cables with clamps. Provide service loops at all connections.
2. Transient Suppression. On all DC relays, provide diodes or other protective devices across the solenoids and holding coils for transient suppression.
3. Power Service Protection.
  - a. Furnish equipment containing readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.
  - b. Provide circuit breakers or fuses that are sized such that no wire, component, connector, PC board or assembly shall be subjected to sustained current in excess of their respective design limits upon the failure of any single circuit element of wiring.
4. Fail Safe Provision. Design the equipment such that the failures of the equipment will not cause the failure of any other unit of equipment. Provide automatic recovery from power failure within 5 seconds after resumption of power.
5. Connectors and Harnesses. Make all external connections by means of connectors. Key the connectors to preclude improper hookups. Color code and/or appropriately mark all wires to and from the connectors.
  - a. Provide connecting harnesses of appropriate length and terminated with matching connectors for interconnection with the communications system equipment.
  - b. Uniquely color code patch fibers with mixed connectors for easy identification
  - c. Plate all pins and mating connectors with not less than 20 microns of gold. For connectors utilizing solder type connections, cover each soldered connection with a piece of heat shrink tubing securely shrunk to insure that it protects the connection.
  - d. Clearly identify all assemblies with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

- H. Software. Provide any and all programming and software required to support the WER system.
  - 1. Install the programming and software in the appropriate equipment at the time of acceptance testing, for use in the acceptance testing.
  - 2. Provide software updates free of charge during the warranty period.
- I. Technical Assistance. Ensure that a manufacturer's technical representative is available on site to assist the Contractor's technical personnel at each installation site and with WER System equipment installation and communication system configuration. Do not power up the WER equipment without the permission of the manufacturer's representative.

System Testing: Conduct System Testing at the manufacturer's facility as well as after installation at the designated City locations:

- a. Test each hop of the proposed system. As a minimum, test transmit power and frequency, receiver performance and frequency, proper operation of switch over, proper operation of alarms and switches and bit error rate (BER) testing for the configured hop. Prior to beginning the manufacturer's test, provide the City's ITS Engineer with a copy of the test procedure as well as the proposed test date(s).
- b. Following completion of equipment installation and operational optimization, shall submit the Acceptance Test Plan to the City's ITS Engineer for review and Approval. During the official Acceptance Testing, provide the technical staff to conduct the measurements and adjustments called for in the testing. The City of Houston reserves the right to participate in the testing as the Official Test Witness. On each page of the Acceptance Test Document, provide for data recording of the test results, and the name of Contractor's representative conducting the test as well as a suitable field for the test date and signature of City's ITS Engineer. Upon City's approval of the Test Plan and the Test Schedule, the Acceptance Testing may begin. This includes:
  - (1) Intersection-level testing of the individual system paths: testing of the installed system paths includes:
    - (a) Measuring and recording the transmitter/receiver channel frequency and polarity.
    - (b) Measuring and recording the transmitter power.
    - (c) Measure and record the receiver fade margin.

- (d) Perform a one hour Bit Error Rate Test (BERT) on the primary equipment and record results.
  - (e) Verify the operation of all local alarm and control points using the alarm/monitoring equipment provided.
- (2) System-level Test: Following intersection-level testing of the individual system paths, test each hop on an end-to-end testing and perform a BERT on the primary equipment.
- 2. Test and verify the operation of the alarm and monitor equipment in accordance with the Acceptance Test criteria.
- 3. Measurement. This Item will be paid by each installation at each intersection.
- 4. Payment. The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for by each intersection. This price includes all equipment described under this item with all cables and connectors, mounting assemblies, all documentation and testing; and the cost of furnishing all labor, materials, training, warranty, equipment, and incidentals necessary to complete the work.

## PART 2 EXECUTION

### 2.01 TESTING & TRAINING

Provide a factory certified representative for installation and testing of the equipment. Conduct a test site survey prior to the installation of the equipment. The City reserves the right to conduct own site survey as needed.

When required, provide up to 2 days of training to personnel of the City in the operation, setup and maintenance of the spread spectrum radio system. Provide instruction and materials for a maximum of 20 persons and at a location selected by the City. Provide instruction personnel certified by the manufacturer. The User's Guide is not an adequate substitute for practical classroom training and formal certification.

Provide updates of the spread spectrum radio software free of charge during the warranty period, including the update to NTCIP compliancy.

### 2.02 WARRANTY

All material, workmanship and labor furnished shall be covered by Supplier(s)/Manufacturer(s) guarantee and/or warranty for a minimum



period of twenty-four (24) months. Warranty period shall begin the day the video detection system is activated by the City of Houston, either as new order or warranty repair. The City of Houston's preference is for all non-warranty service to be charged a singular flat rate.

Successful bidder shall bear all expenses connected with return of any material, which the City deems necessary to return for adjustments during warranty period.

Successful bidder shall bear all labor cost associated with warranty items and maintenance in a timely manner; the quality of timely service is determined by the City's ITS Engineer and shall not exceed twenty-four (24) hours from the Time of Notification (TON) to initial field response by the successful bidder or their representative. In essence, the successful bidder shall provide maintenance and field service (i.e. trouble calls) during the warranty period.

Supplier(s)/Manufacturer(s) shall make all engineering data, diagrams, software changes or improvements, which increases performance of equipment purchased under this bid, available to the City of Houston at no additional cost.

Supplier(s)/Manufacturer(s) shall have field engineers or technicians available on request to assure satisfactory initial operation, and to consult with City's Traffic Engineer, or his representative, on any special circuitry that may be required in certain applications.

END OF SECTION